

**What is claimed is:**

1           1. A voice detector comprising:  
2           a plurality of Goertzel filters each operating at a different frequency  
3           within a voice range, some of the filters operating at frequencies of control  
4           signals and others of the filters operating at frequencies other than the  
5           control signals' frequencies, each filter for receiving a signal to be  
6           analyzed for presence of voice and detecting energy of the signal at the  
7           operating frequency of the filter; and  
8           a comparator connected to the filters, for comparing the energies  
9           detected by the filters against thresholds and responsive to at least three  
10          of the filters simultaneously detecting energy above a noise threshold and  
11          below a control signal threshold by indicating that the signal comprises  
12          voice.

1           2. The voice detector of claim 1 wherein:  
2           the comparator is responsive to a filter of the filters operating at a  
3           frequency of a control signal and detecting energy above a control signal  
4           threshold by indicating that the analyzed signal comprises the control  
5           signal.

1           3. The voice detector of claim 1 wherein:  
2           the comparator is responsive to one of the filters operating at a  
3           frequency of a single-frequency control signal detecting energy above a  
4           first control signal threshold by indicating that the analyzed signal  
5           comprises the single-frequency control signal, and is responsive to two of  
6           the filters operating at frequencies of a dual-frequency control signal each  
7           detecting energy above a second control signal threshold different from  
8           the first control signal threshold by indicating that the analyzed signal  
9           comprises the dual-frequency control signal.

1           4. The voice detector of claim 1 further comprising:  
2           a detector that detects total energy of the signal to be analyzed;  
3 wherein  
4           the comparator is responsive to the total detected energy being  
5 below a noise threshold by indicating that the analyzed signal comprises  
6 noise or silence.

1           5. The voice detector of claim 4 wherein:  
2           the comparator compares the energies detected by the filters  
3 against the thresholds by comparing ratios of the energies detected by  
4 individual ones of the filters and the total detected energy against the  
5 thresholds.

1           6. A call classifier comprising:  
2           a plurality of Goertzel filters each operating at a different frequency  
3 within a voice range, some of the filters operating at frequencies of control  
4 signals and others of the filters operating at frequencies other than the  
5 control signals frequencies, each filter for receiving windows of a signal to  
6 be analyzed for presence of voice and detecting energy of the signal in the  
7 windows at the operating frequency of the filter;  
8           a detector that detects in the windows total energy of the signal to  
9 be analyzed; and  
10          a comparator connected to the filters, for comparing ratios of the  
11 energies detected by the individual filters in a window and the total  
12 detected energy in the window against thresholds, responsive to the total  
13 detected energy in the widow not exceeding a noise threshold by  
14 indicating that the analyzed signal comprises silence or noise, responsive  
15 to one of the filters operating at a frequency of a single-frequency control  
16 signal detecting energy whose ratio exceeds a first control signal threshold  
17 by indicating that the analyzed signal comprises said single-frequency  
18 control signal, responsive to two of the filters operating at frequencies of a

19 dual-frequency control signal each detecting energy whose ratio exceeds  
20 a second control signal threshold by indicating that the analyzed signal  
21 comprises said dual-frequency control signal, and responsive to at least  
22 three of the filters each detecting energy whose ratio exceeds a voice  
23 threshold by indicating that the signal comprises voice.

1 7. The call classifier of claim 6 wherein:  
2 each window represents a different segment of the signal to be  
3 analyzed.

1 8. The call classifier of claim 6 wherein:  
2 each window represents a different tapered segment of the signal  
3 to be analyzed.

1 9. The call classifier of claim 6 wherein:  
2 each window represents a different segment of the signal to be  
3 analyzed and wherein consecutive said windows partly overlap each  
4 other.

1 10. A method of detecting voice in a signal to be analyzed for  
2 presence of voice, comprising:  
3 detecting energy of the signal at operating frequencies of a plurality  
4 of Goertzel filters each operating at a different frequency within a voice  
5 range with some of the filters operating at frequencies of control signals  
6 and others of the filters operating at frequencies other than the control  
7 signals' frequencies;  
8 comparing the energies detected by the filters against thresholds;  
9 and  
10 in response to at least three of the filters simultaneously detecting  
11 energy above a noise threshold and below a control signal threshold,  
12 indicating that the signal comprises voice.

1           11. The method of claim 10 further comprising:  
2           in response to a filter of the filters operating at a frequency of a  
3           control signal detecting energy above a control signal threshold, indicating  
4           that the analyzed signal comprises the control signal.

1           12. The method of claim 10 further comprising:  
2           in response to one of the filters operating at a frequency of a single-  
3           frequency control signal detecting energy above a first control signal  
4           threshold, indicating that the analyzed signal comprises the single-  
5           frequency control signal; and  
6           in response to two of the filters operating at frequencies of a dual-  
7           frequency control signal each detecting energy above a second control  
8           signal threshold different from the first control signal threshold, indicating  
9           that the analyzed signal comprises the dual-frequency control signal.

1           13. The method of claim 10 further comprising:  
2           detecting total energy of the signal to be analyzed;  
3           comparing the total detected energy against a noise threshold; and  
4           in response to total detected energy being below the noise  
5           threshold, indicating that the analyzed signal comprises noise or silence.

1           14. The method of claim 13 wherein:  
2           comparing the energies detected by the filters comprises  
3           comparing ratios of the energies detected by individual ones of the  
4           filters and the total detected energy against the thresholds.

1           15. A method of detecting voice in a signal to be analyzed for  
2           presence of voice, comprising:  
3           detecting energy of the signal at operating frequencies of a plurality

4 of Goertzel filters each operating at a different frequency within a voice  
5 range, some of the filters operating at frequencies of control signals and  
6 others of the filters operating at frequencies other than the control signals  
7 frequencies, wherein each filter receives windows of the signal to be  
8 analyzed for presence of voice and detects energy of the signal in the  
9 windows at the operating frequency of the filter;  
10 detecting in the windows total energy of the signal to be analyzed;  
11 comparing ratios of the energies detected by the individual filters in  
12 a window and the total detected energy in the window against thresholds;  
13 in response to the total detected energy in the widow not exceeding  
14 a noise threshold, indicating that the analyzed signal comprises silence or  
15 noise;  
16 in response to one of the filters operating at a frequency of a single-  
17 frequency control signal detecting energy whose ratio exceeds a first  
18 control signal threshold, indicating that the analyzed signal comprises said  
19 single-frequency control signal;  
20 in response to two of the filters operating at frequencies of a dual-  
21 frequency control signal each detecting energy whose ratio exceeds a  
22 second control signal threshold, indicating that the analyzed signal  
23 comprises said dual-frequency control signal; and  
24 in response to at least three of the filters each detecting energy  
25 whose ratio exceeds a voice threshold, indicating that the signal  
26 comprises voice.

1 16. The method of claim 15 wherein:

2 each window represents a different segment of the signal to be  
3 analyzed.

1 17. The method of claim 15 wherein:

2 each window represents a different tapered segment of the signal  
3 to be analyzed.

- 1           18. The method of claim 15 wherein:
- 2           each window represents a different segment of the signal to be
- 3 analyzed and wherein consecutive said windows partly overlap each
- 4 other.